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The predominance of economic development in the support for large-scale wind farms in the U.S. Great Plains

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ABSTRACT

Wind energy is one of the fastest growing sources of power generation in the world. While general public and political support for wind energy is often high, siting wind farms frequently raises concerns in local communities, and individual projects often fail because of effective public opposition. This paper presents the results of a postal and online survey questionnaire that explores public perceptions of wind energy in two of the most important states for wind development, Texas and Iowa. The goal is a better understanding of public reactions to large-scale wind developments as a prerequisite of more widespread use of renewable energy resources. We found a high level of public support for wind energy, with more than two-thirds of respondents being in favor of building more wind farms either in their community or within the U.S. as a whole. Given that the majority of respondents had a very high level of concern for the general environment, we also found that almost two-thirds of respondents counter-intuitively indicated that producing electricity using fossil fuels is not detrimental to the environment, and that they had little concern for global climate change. Our results suggest that arguing for more renewable sources of energy based on reducing our carbon footprint is less persuasive in these communities than simply approaching it from the perspective of wind being a clean and safe source of energy. More than two-thirds of respondents felt their county had benefited economically from the wind farms and that they were a source of job creation in the county. Support for wind power in these communities is associated far more with socioeconomic factors than foundational aesthetic or moral values, with wind farms perceived as the vehicle that will reverse economic decline.

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1. Introduction and background

Wind energy is one of the fastest growing sources of power generation in the world. In the U.S., growth has achieved 25–50% per year over the past five years [1], and wind energy now supplies approximately 2.5% of annual U.S. electricity consumption [2]. Such growth has resulted from concern over climate change, energy security, and the cost of fossil fuels, as well as from policy support, which has made wind a viable investment opportunity in specific markets [3,4] and one of many possible "wedges" for stabilizing carbon emissions [5].

Wind energy has also been recognized as one of the most environmentally benign sources of electricity generation: it causes no emissions of harmful pollutants, including the greenhouse gas carbon dioxide; does not require mining or drilling for fuel; does not produce radioactive or hazardous wastes; and does not use water for steam generation or cooling [6–8]. Because of the perceived environmental benefits of wind energy, public support for expanding wind energy development is often high [9]. The dramatic growth in wind power development has, however, raised a number of challenges for the industry. These include potential impacts to wildlife, particularly birds and bats [10,11], visual and noise impacts on communities [12–15], issues relating to siting [16–18], and the ability to more clearly identify the system-wide environmental and emissions impacts from wind energy [19]. Many of the impacts from wind energy projects are predominately local (e.g., wildlife displacement, visual and noise impacts, economic development impacts). Thus, while general public and political support for wind energy is high, siting wind farms frequently raises concerns in local communities, and individual projects often fail because of highly visible public opposition.

With wind energy capacity increasing so rapidly, it is important to develop a better understanding of how wind energy is perceived by the general public. A sizable literature has developed on the topic, with studies examining attitudes toward wind energy now coming from many areas of the world including Australia [20], Greece [21–24], the Netherlands [25], Scotland [7,26–28], Sweden [13,29,30], the United Kingdom [31–33], and the United States [9,17,34–36]. A number of these studies explore the social acceptance of renewable energy in general [37–40] while others target wind energy specifically [9,35,36,41,42]. Some of the most notable studies explore topics including community involvement [20,43], attitudes of electricity consumers [17,29], and planning/policy implications [44–46]. Several key questions have emerged from this research, including:

1. What natural conditions influence public attitudes?
2. What social conditions influence public attitudes?
3. What are the relative roles of various environmental impacts from wind turbines on public attitudes?
4. Are offshore wind turbines preferred over on-shore wind turbines?
5. What roles do proximity and location have in influencing public attitudes?
6. How do public perceptions toward wind farms change over time?
7. Does the NIMBY (Not-In-My-Backyard) phenomenon adequately explain wind farm opposition?

We propose to address some of these questions in two of the most important states for wind development in the U.S., Texas and Iowa. At year-end 2010, Texas had 10,085 MW and Iowa had 3675 MW [1]. Iowa is the first state to exceed 10% wind energy of their electricity generation on an annual basis with Texas approaching 8% [1]. These two states received more than $4 billion of investments in 2009 alone. Additional investments could amount to much more; taken together, Texas and Iowa hold 2471 GW of potential installed capacity.[1]

Impressive as it is, stating the cumulative capacity masks the scale of the individual developments. For example, Texas is home to some of the world's largest wind farms at Roscoe (782 MW), Horse Hollow (735.5 MW) and Capricorn Ridge (662.5 MW). Yet, despite the scale of existing wind development in Texas and Iowa, and regardless of the huge development potential, there has been little research on public attitudes toward wind energy conducted in either state. Continued rapid development, especially of large wind farms, prompts a more thorough understanding of public perceptions in both states.

Such evaluation has recently begun for a county in west Texas. Brannstrom et al. [36] used the Q-method to examine social perspectives on wind power, focusing specifically on the complex, multidimensional nature of public perceptions of wind farms. The present paper is a complement to Brannstrom et al. [36], but uses a different method and scale. It presents the results of a postal and online survey questionnaire as it explores public perceptions of wind energy in Texas and Iowa. Ultimately, we aim to better understand public reactions to large-scale wind developments as a step toward more widespread use of renewable energy resources in one of the most productive wind energy areas in the world.

2. Methods

2.1. Study sites

We conducted research in several communities near wind farms in west Texas and Iowa (Fig. 1). Table 1 gives the characteristics of the wind farms near these communities. Table 2 gives the demographic data on the counties within which the farms reside. Capricorn Ridge is the largest wind farm located in Sterling and Coke counties (combined population = 4605), with Sterling City (population = 824) the closest town to the farm at approximately 3 miles. It has 407 turbines with an installed capacity of 662.5 MW. The Roscoe Wind Farm and Horse Hollow Wind Energy Center, located in Nolan and Taylor counties, are the two largest wind farms in the world, with a total of 1048 turbines and an installed capacity of 1517 MW. We chose the area to represent a more densely populated (141,306) and more economically robust community relative to the rural community represented by Capricorn Ridge and surrounding wind farms. Abilene, the largest city in the two-county region, has a population of 103,382 and lies approximately 10 miles from the nearest wind farm. The Iowa study area is defined by an eight-county, approximately 60 square mile, region in north-central Iowa, comprised of Cerro Gordo, Franklin, Hancock, Humboldt, Kossuth, Winnebago, Worth, and Wright counties. Total population differs among the eight counties, varying from more populated Cerro Gordo county (46,447 people) to less populated Wright county (7909 people). Despite differences in population, approximately 55% of each county's population is employable (between the ages of 16 and 65). This study area in Iowa represents a community similar in population and size to Nolan and Taylor counties in Texas. Several wind farms are located in the study area with the Crystal Lake Wind Farm being the largest with 416 MW of installed capacity (Table 1).

2.2. Survey methodology

We developed a survey questionnaire to assess perceptions of wind energy, as well as general attitudes about energy and the

[1] Installed capacity is the potential GW of rated capacity that could be installed on the available windy land area (DOE, 2011).

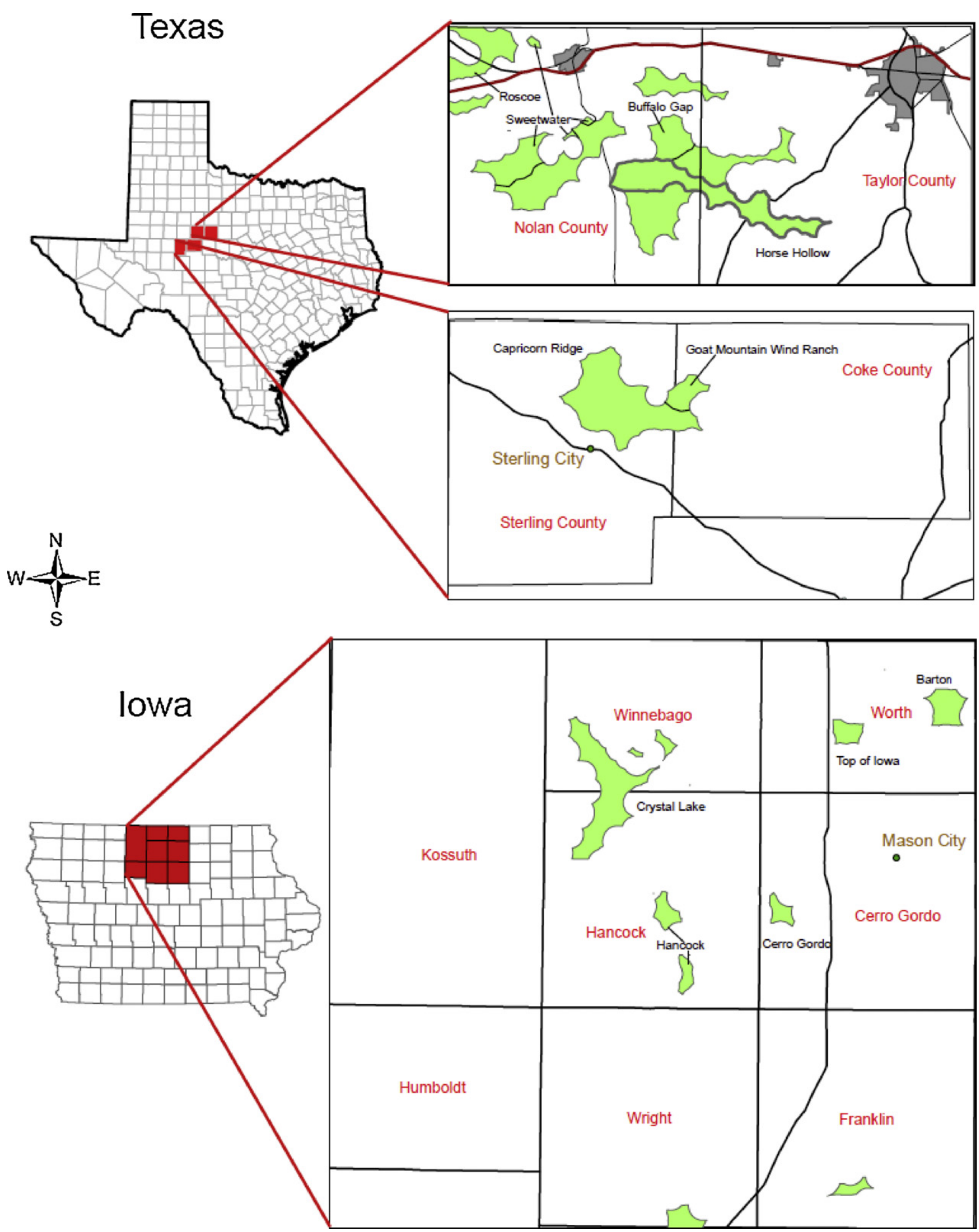


Fig. 1. Study regions showing location of major wind farms (see also Table 1).

environment in the local community (copies available from the authors). The survey was developed primarily from results of a pilot study in which focus groups identified key issues related to wind energy developments [47]. In addition, we derived several questions from survey questionnaires used in previous studies [7,9,48]. A mix of closed, open, and supplementary questions was used as suggested by Warren et al. [7]. For most closed questions, the survey asked respondents to indicate their level of agreement from Strongly Agree to Strongly Disagree (i.e., five-point scale) for issues relating to: (1) overall attitude toward wind energy; (2) knowledge of wind energy; (3) viewshed; (4) construction and operations; (5) permanent socio-economic effects; and (6) environmental attitudes. We developed questions to help identify the physical and environmental characteristics linked to both negative and positive perceptions of wind farms. For this study, we chose to use a postal survey over other methods such as personal interviews and

Table 1
Wind farm characteristics.

Wind farm	County	State	Date operational	Total MW	Total turbines
Capricorn Ridge	Coke and Sterling	Texas	2007	662.5	407
Goat Mountain Wind Ranch	Coke and Sterling	Texas	2008/2009	150	109
Horse Hollow Wind Energy Center	Nolan and Taylor	Texas	2006	735.5	421
Buffalo Gap	Nolan and Taylor	Texas	2007/2008	535	296
Roscoe Wind Farm	Nolan and Taylor	Texas	2008/2009	781.5	627
Sweetwater Wind Farm	Nolan	Texas	2003/2007	585	392
Barton	Worth	Iowa	2009	160	
Top of Iowa	Worth	Iowa	2001/2008	189.8	187
Crystal Lake	Hancock and Winnebago	Iowa	2008	416	224
Cerro Gordo	Cerro Gordo	Iowa	1999	41.3	55
Hancock	Hancock	Iowa	2002	97.7	148

the door-to-door questionnaire mainly because it was the most cost efficient. Although there are several benefits and disadvantages to using postal surveys, the method often gives opportunity for respondents to read over questions more thoroughly and contemplate questions further [29]. Surveys are best suited to divulge emotional responses and attitudes held by individuals surrounding the project [36,49]. This method was also best suited for use with a geospatial database that allowed survey responses to be separated into various geographic zones to examine the effect proximity had on public attitudes, while preserving the anonymity of respondents.

We also conducted research to determine what effect proximity and location had on wind energy attitudes. Respondents were asked to identify how closely they live to wind farms. We used a geospatial database to map the location of the wind turbines using geographic information systems (GIS), within ArcMap (ESRI Inc.). We obtained a database of addresses for households living within the study areas. Addresses were then geocoded to associate their location with geographic coordinates.[2] Geocoding helped to identify how close households were located to corresponding wind farm developments and verify the respondent's answers regarding proximity. In addition, this method allowed us to analyze results corresponding to such differences in distance to wind farms. We selected participants in each study area according to the random sampling method. A random sample of households was generated from the addresses located within the study area with surveys mailed in November 2008 (Capricorn Ridge), July 2009 (Horse Hollow) and July 2010 (the Iowa wind farms). Reminder postcards were sent ten days after the initial mailing to give participants the option of completing the survey questionnaire online. In total, 5960 surveys were mailed to households in 12 counties with an average overall response rate of 10.7% (Table 3).

3. Results

3.1. Demographics and knowledge of wind industry

A relatively even distribution of males (51%) and females (44%) participated in the survey questionnaire (5% did not indicate gender). The majority of respondents (62%) are 35 years and older with 53% aged 55 and over. The sample does not include individuals under the age of 18. Aside from excluding this age group, the sample is largely representative of people living locally (among age and sex). Survey respondents were mainly long-term county residents – 61% of all respondents residing within the target counties for over 20 years, and less than 4% having moved to the area within the last two years. Fifty five percent of respondents report living within 10 miles of any wind farm within the study area. Most respondents (79%) live within 20 miles of the turbines with 22% residing less than five miles from turbines.

Forty seven percent of respondents held college degrees (23% held advanced degrees), most respondents (70%) had at least some college and only 2% had not completed high school. In terms of income, 70% of respondents reported earning between $20,000 and $80,000 per annum with 8% making less than $20,000 and 21% making more than $80,000 per annum. Most respondents indicated that they had at least "some knowledge" of renewable energy (61%) and wind energy (65%). Respondents were also asked to indicate what sources they gained knowledge from: television (26%), news articles/shows (29%) and the internet (15%) were cited most frequently. In addition, 479 respondents (78%) indicated that they had not attended a public meeting regarding wind energy prior to construction. During the time of the surveys, a total of 12 respondents (3%) indicated that they had wind turbines located on their property.

3.2. Environmental attitudes

We included several questions regarding attitudes toward key environmental issues in the survey questionnaire (Fig. 2). General attitudes regarding the protection of the environment were largely positive. Protection of the environment was very important for most respondents (93%) as was the conservation of water (90%). On the other hand, when asked about level of concern regarding global climate change, there was a significant decrease in those expressing concern (59%). This corresponds with a significant percentage of respondents (58%), who were either neutral or disagreed with the statement "the use of fossil fuels for generating electricity is detrimental to the environment." Respondents were also asked if current global climate change is caused by man-made emissions. The majority of respondents (50%) agreed or strongly agreed with the statement, 28% were neutral, while a lower percentage (22%) disagreed or strongly disagreed. In addition, a small amount of respondents (9%) indicated that they do not believe climate change is occurring. Most respondents believe that the U.S. should use more renewable energy (87%) and wind energy (84%) to fulfill energy demands. On the other hand, a much smaller proportion of respondents (42%) would be willing to support renewable energy if it cost more than energy derived from fossil fuel sources. There was no significant difference between the responses across the three study sites.

Attitudes regarding climate change were also compared to general attitudes toward wind energy (Table 4). Respondents who indicated positive support for wind energy did so irrespective of their concern (or lack thereof) about global climate change. Of the number of respondents who agree that fossil fuels are detrimental to the environment, 55% indicated strong support for wind energy.

[2] Addresses were not geocoded for the Capricorn Ridge study in Coke and Sterling Counties. Given the small population of the study area, geocoding could potentially have lead to identifying a response to a specific household, thereby voiding the anonymity of the study.

Table 2
County Characteristics for the Texas and Iowa study sites.[a]

County	State	Total pop/pop. 16 years and older	Median age (years)	% High school/% bach. degree	Mean household size	Vacant housing units (%)	In labor force (%)	Median income ($2009)	Male/female (%)	Race (% white)	County seat
Coke	TX	3491 2432	48.1	80.8 11.3	2.23	51.4	51.4	33,375	49.9/50.1	94.3	Robert Lee
Sterling	TX	1114 769	42.1	72.4 22.0	2.46	32.0	60.4	38,750	46.5/53.5	88.2	Sterling City
Nolan	TX	14,719 9487	37.7	75.7 18.0	2.41	16.5	63.7	37.481	48.9/51.1	75.4	Sweetwater
Taylor	TX	126,587 77,388	32.1	83.8 23.3	2.43	9.4	65.3	40,363	48.2/51.8	80.2	Abilene
Cerro Gordo	IA	43,927 30,595	42.3	91.9 21.5	2.20	11.4	68.4	44,770	48.3/51.7	95.1	Mason City
Franklin	IA	10,594 7231	42.0	84.0 14.1	2.53	14.2	65.1	44,813	49.7/50.3	92.0	Hampton
Hancock	IA	11,339 7784	43.8	88.1 15.4	2.34	10.7	68.0	48,634	49.5/50.5	97.0	Garner
Humboldt	IA	9645 6653	44.4	88.5 15.9	2.17	8.7	65.6	46,420	49.5/50.5	96.3	Dakota City
Kossuth	IA	15,495 10,869	46.2	89.7 16.5	2.21	11.4	63.9	46,176	48.8/51.2	98.8	Algona
Winnebago	IA	11,723 7278	43.3	88.9 16.6	2.21	10.0	65.5	39,694	49.3/50.7	97.0	Forest City
Worth	IA	7620 5367	43.8	89.7 15.6	2.32	8.5	68.1	49,871	50.4/49.6	97.7	Northwood
Wright	IA	13,039 9058	44.1	87.4 14.6	2.27	15.3	64.1	42,859	49.5/50.5	93.7	Clarion

[a] Data from 2005 to 2009 American Community Survey 5-Year Estimates (www.factfinder.census.gov); based on data collected over a 5-year time period. The estimates represent the average characteristics of population and housing between January 2005 and December 2009 rather than a single point in time.

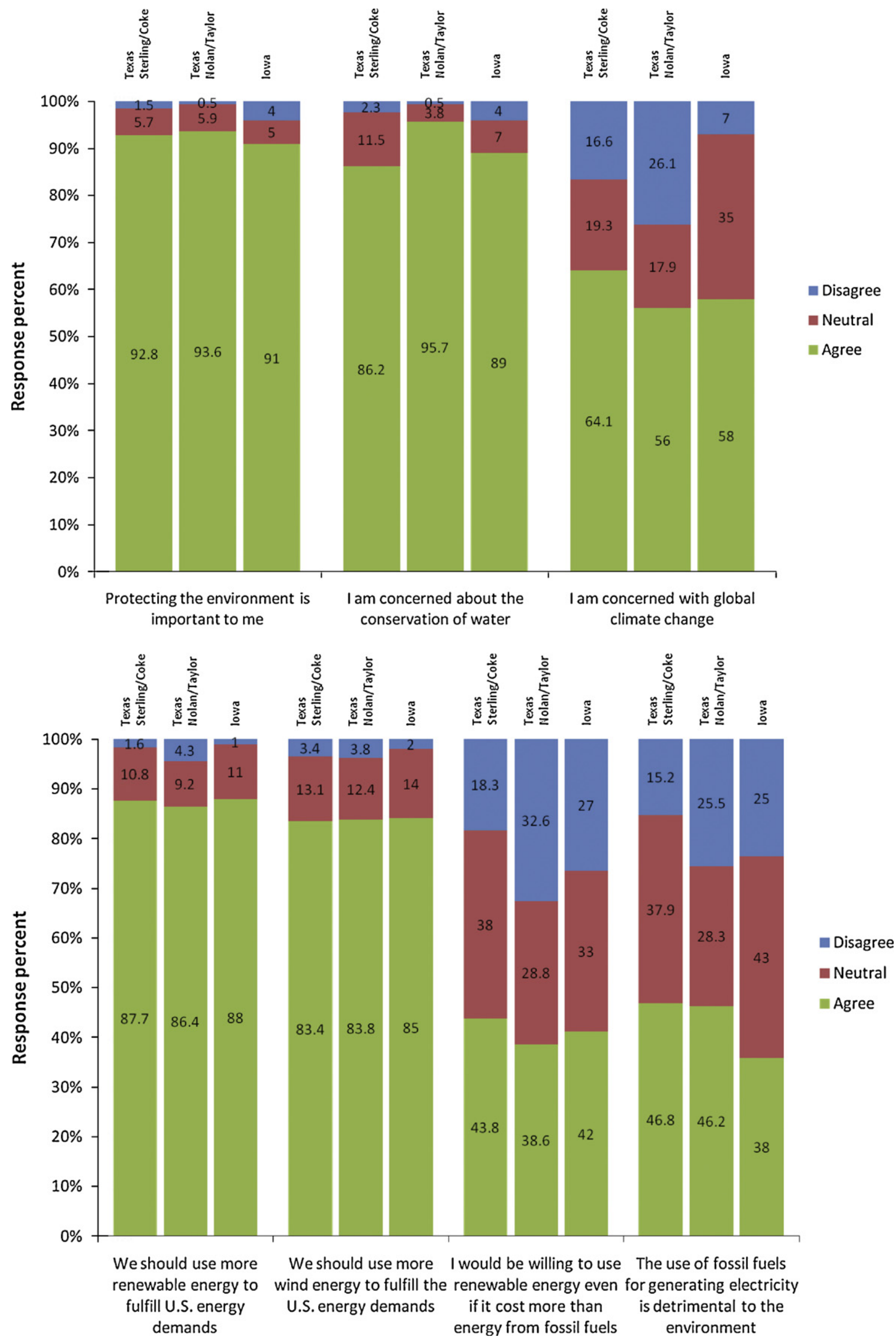


Fig. 2. Survey results reflecting environmental attitudes toward win energy.

Table 3
Survey statistics.

Counties	Study area households	Surveys mailed	Survey responses (*n*)	Response rate (%)[a]
Coke/Sterling	3654	1558	158	10.1
Nolan/Taylor	61,135	2126	185	9.2
Crystal Lake, Cerro Gordo, and Hancock	41,762	2276	274	12.5

[a] Response rate calculation does not include surveys returned from vacant or undeliverable households.

Of those who disagreed that fossil fuels are detrimental to the environment, a smaller though still significant number (42%) indicated support for wind energy. A similar relationship between these topics is also found regarding negative attitudes toward wind energy, although less than 10% of respondents were negative toward wind, independent of their concerns for global climate change or the use of fossil fuels.

3.3. Wind energy attitudes

Several questions regarding wind energy attitudes were included in the survey questionnaire. When asked about their attitudes prior to construction, the majority of respondents (72%) indicated either a positive (47%) or very positive (25%) attitude toward wind energy, even though 39% reported that they had little, if any, knowledge of renewable energy as a whole. Only a small proportion of respondents (4%) indicated a negative or very negative attitude toward wind energy prior to construction. The age group indicating the highest ratio of positive attitude toward wind energy was ages 18–24 (75% positive). The age category indicating the highest ratio of negative attitude toward wind energy was ages 65–74 (25% negative). Post-construction perceptions toward wind energy remained favorable with 76% of respondents having positive or very positive attitudes. The positive perception of wind farms was supported by the fact that 70% of respondents were in favor of building more wind farms in their county, regardless of age, proximity, or environmental attitude.

Results regarding general attitudes toward wind energy suggest that the overall perception toward wind energy is favorable (Table 5). There are a number of noteworthy findings regarding noise and visual impact of the wind farm. A fairly small proportion of respondents indicated that wind energy creates a disturbing noise and strobe effect from the blades (16 and 10%, respectively). Almost one-third of respondents (32%) indicated that wind farms are an unattractive feature of the landscape. However, 71% of respondents indicated that having wind farms allows multiple land use and allow land to be reverted to its natural state (41%). Interestingly, only 18% of respondents felt turbines created a danger for wildlife.

Table 4
Climate-change related attitudes corresponding to level of support for wind energy (positive and negative).

Response indicated	Positive support for wind (%)	Negative support for wind (%)
Concerned about global climate change	50	1.4
Not concerned about global climate change	38	6
Use of fossil fuels for generating electricity is detrimental to the environment	55	4
Use of fossil fuels for generating electricity is not detrimental to the environment	42	5

The survey also included questions pertaining to the practicality of wind energy technology. A large number of respondents (82%) indicated that wind energy is a clean as well as a safe source of energy production (86%). A large portion of respondents (80%) also agreed that wind energy is a renewable (i.e., limitless) resource and results in no greenhouse gas emissions (76%). Findings also suggest that respondents are relatively unsure whether wind energy is a reliable source of electricity. While 40% of respondents agreed that wind energy is reliable, 20% of respondents said it was unreliable with 35% indicating a neutral stance.

The survey included 13 statements relating to socio-economic impacts and respondents were asked to indicate their level of agreement from Strongly Agree to Strongly Disagree (Table 6). Respondents found the long-term social and economic benefits to be positive, with 69% of the respondents finding that their county has benefited economically from the wind farms and 71% of the respondents stating that the wind farms were a source of job creation in the county. Crime was not found to be an ongoing issue with only 4% of the respondents agreeing with the statement. The majority of the respondents expressed positive opinions to the statements that “wind farms increased tax revenue which benefits the community and schools” (59%), that “wind energy increases property values” (41%), and that “wind farms create local industry in the community” (72%). Of the potential negative impacts, the majority of respondents disagreed with statements such as “wind energy disrupts a sense of community”, “wind energy brings too many outsiders”, or “wind energy has increased crime”. The only issue associated with construction of the wind farms was traffic: 37% of respondents indicated that traffic has increased in the community as a result of construction of the farm.

Survey participants were also given the opportunity to indicate the locations where they most often see wind turbines (Table 7). Most noteworthy of these findings are that a large majority of

Table 5
General wind energy attitudes.

Wind energy	Agree (%)	Disagree (%)	Neutral (%)
Causes TV interference	6	49	42
Creates a disturbing noise from turbines	16	43	36
Creates a strobe affect from turbine blades	10	43	44
Allows land to be reverted to its natural state	41	21	32
Allows multiple land use	71	6	17
Is an unattractive feature of the landscape	32[a]	33	31
Is a danger to wildlife	18	46	30
Is a safe energy source	86	3	8
Is a clean energy source	82	4	9
Results in no greenhouse gas emissions	76	4	18
Requires little or no water	72	3	21
Is an unreliable output of electricity	20	40	35
Is a renewable resource	80	4	13

[a] This was the only question where we found a significant difference between the Iowa and Texas responses. For Iowa and the Horse Hollow area, 27 and 25% of respondents, respectively, agreed with this statement; for Capricorn Ridge, 43% of respondents agreed.

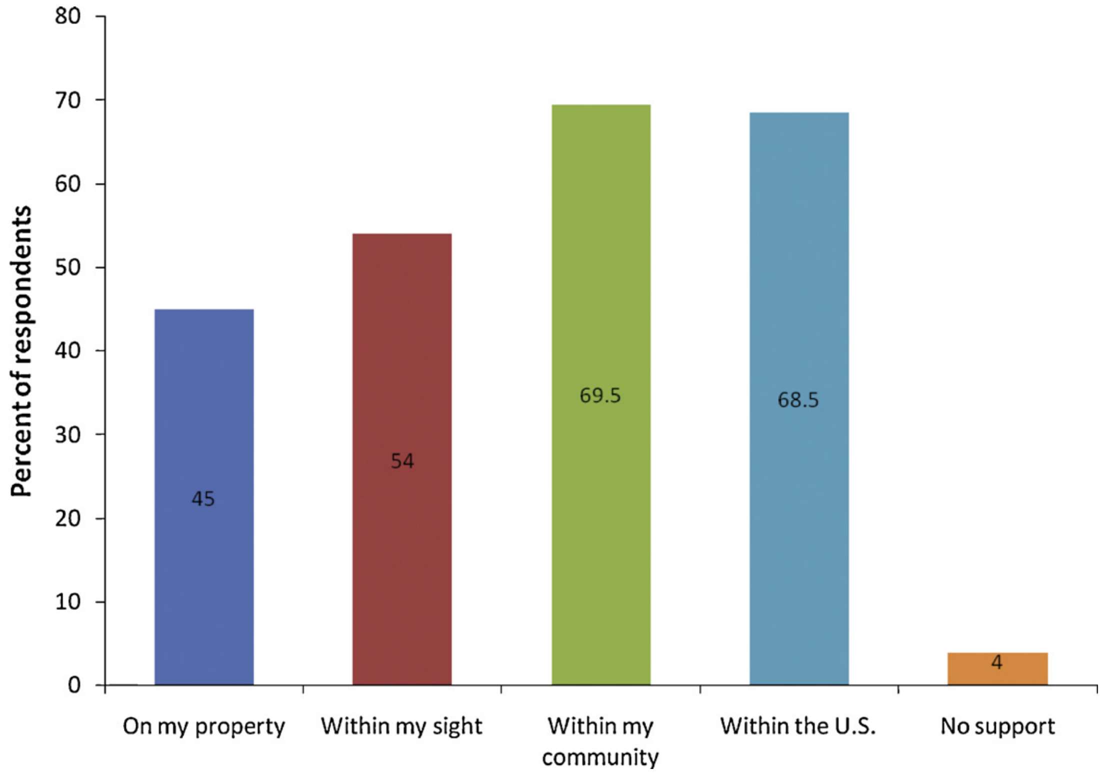


Fig. 3. Combined survey results for Texas and Iowa reflecting overall level of support for wind farms.

respondents (85%) see wind turbines when they are driving, while a much lower proportion (18%) of respondents indicating they see turbines from their home. Respondents were also asked about their willingness to support more wind farms in various locations (Fig. 3). Overall, there was strong support for more wind farms, with more than two-thirds in favor of building more wind farms either in their community or within the U.S. as a whole.

Table 6
Wind energy attitude relating to socio-economic impacts.

Wind energy	Agree (%)	Disagree (%)	Neutral (%)
Increases property values	41	20	34
Disrupts a sense of community	6	64	27
Has created local industry in my community	73	6	19
Has resulted in new residents moving to my community	49	16	32
Has benefitted my county economically	69	7	22
Has created jobs in my community	71	5	19
Has increased traffic in my community	37	22	37
Has led to companies actively donating in my community	37	11	47
Has increased tax revenues in my community	59	6	31
Has benefitted my county schools because of increased tax revenues	56	8	33
Has led to an increase in crime	4	61	30
I am in favor of building more wind farms in my county	68	8	21
Brings in too many "outsiders"	3	67	27

4. Discussion

A notable aspect of the results presented here is the overall level of public support for wind energy. The communities studied show a very positive attitude toward the wind farms and wind energy in general, with more than two-thirds of respondents being in favor of building more wind farms in their community. Individuals who oppose wind energy and the local wind farm projects are in a small minority. The results linking wind energy attitudes to "higher concepts", such as protection of the environment and climate change [44], are also broadly consistent with a recent study on public attitudes of wind energy in north-central Texas [9]. While the majority of respondents had a very high level of concern for the general environment (93%) and water conservation (90%), a significant proportion of respondents (58%) indicated that producing electricity using fossil fuels is not detrimental to the environment (with no significant difference between the Texas and Iowa respondents). In addition, while respondents in both states overwhelmingly supported the use of renewable energy in general, and wind energy in particular, to help fulfill U.S. energy demands, they would be far more reluctant to do so if the renewable source cost more than conventional, fossil-based sources. The results also suggest that arguing for more renewable sources of energy based on reducing

Table 7
Locations wind turbines are most often seen.

	Response (%)
When at home	18
When driving	85
When in town	9
When walking in the countryside	6

Note: Respondents were allowed to indicate multiple answer choices.

our carbon footprint (and, by extension, mitigating against climate change) would be far less persuasive in these communities than simply approaching it from the perspective of wind being a clean and safe source of energy.

The results reported here also support the findings of Brannstrom et al. [36], who conducted a Q-method analysis of social perspectives on wind power development in a single county in west Texas. These authors identified "Wind Welcomers" as the most prominent group: those who see wind power development as having had an overwhelming positive impact on the economy and community. Respondents in Brannstrom et al. [36] described how the city of Sweetwater, for example, was struggling and starting to lose population, but that schools were starting to see stability in enrollment since arrival of the wind farms, and that the area as a whole was beginning a revival. Respondents also noted that the arrival of wind power meant that ranchers and farmers could keep ranching and farming because there was enough confidence in the residual income generated by the wind farms. Our results support this sentiment, with more than 70% of respondents indicating that having wind farms allowed multiple land use and 41% noting that land could reverted to its natural state as a result of the wind farms. In fact, in Brannstrom et al. [36], Wind Welcomers emphasized how wind turbines fit into the productive landscape of farming, ranching, and hunting, as Sowers [50] reported for northern Iowa. One government official and landowner, for example, admitted his initial skepticism that hunting and wind could coexist, but went on to argue that wildlife returned "within six months of construction . . . I guide right underneath these things [turbines] . . . nature adapts and it overcomes" [36]. Overall, Brannstrom et al. [36] found that residents claimed significant local economic impacts from wind, agreeing with statements such as "The wind energy companies have provided jobs, use supplies, and buy gasoline from local businesses" and that "the wind industry has been good for the merchants of Nolan County and has allowed for tax values to increase, which leads to lower tax rates." In general, respondents rejected statements that were strongly critical of the wind industry, such as "several businesses are failing now because the wind industry has left" and that "the wind industry has horribly impacted the local housing market, as it impossible to rent an apartment." Our results support these findings.

Previous literature has stated that visual impact is one of the most important environmental issues related to wind energy [51–53]. Devine-Wright [44] argues that, despite a large emphasis on visual impacts present in most studies, there is little evidence that wind turbines are *universally* perceived as unsightly. Our results support this view, with one-third of respondents indicating that wind turbines are unattractive but a significant number (28%) indicating that wind turbines are actually an attractive feature of the landscape. Interestingly, more positive visual evaluations of wind farms are also beginning to appear in the literature [9,44]. While the visual impact of a wind energy landscape is indeed important, it is also apparent that this impact will vary greatly across unique locations and societies. Levels of environmental concern will undoubtedly differ by location and will depend greatly on local context and place attachment [49,54,55]. For example, in Coke and Sterling counties, several respondents expressed concern that turbines were visible from Fort Chadbourne, a Texas State Historical Site that was also added in 1973 to the National Register of Historic places. One respondent commented that "The impact of having rotating blades within sight of historical site of Fort Chadbourbe (sic) is not appealing" while another wrote "My husband and I have spent 10 years building up Fort Chadbourne. I was for the windmills until they ruined the historic view . . . now they stand out all around the fort." Overall, 43% of respondents in Coke and Sterling agreed with the statement "turbines are an unattractive feature of the landscape", versus 25% of respondents in Iowa and communities closest to the wind farms in Nolan and Taylor counties, indicating a stronger sense of resentment, aesthetically speaking, toward the wind turbines. We postulate the reason for this is that, at Capricorn Ridge, turbines are located primarily along the edge of a mesa and are visible for many miles (Fig. 4). Anecdotal evidence, as well as informal interviews conducted with residents in the town of Sterling City, confirmed that some people felt the turbines had taken away from the blue sky, west Texas vistas. One respondent wrote: "My family has lived here in the county for over 100 years. I have mountains around two sides of my place and I didn't want to get up the rest of my life looking at any man-made object. But this wind is a source that will always be here and there are a lot of people in this area who will be able to benefit from this resource greatly. And I will accept the sight for the gain of others." In Iowa in particular, it appears that individuals are more accepting of wind turbines and are even beginning to view them as a pleasing aspect of the landscape. One possible reason for this is that the wind farms here are more established, some being operational since 1999, and there has been enough time for residents to become more accustomed to them.

There were significant differences in attitudes between the Iowa and Texas respondents specifically relating to the socio-economic impacts of the wind farms. For example, only 52% of Iowans felt the wind farms had benefitted their counties; in Texas, 77% of respondents at both locations felt this was the case. Similarly, 54% of Iowans felt the wind farms had created jobs in their community versus 72 and 87% at Capricorn Ridge and Horse Hollow, respectively. For questions relating to increased tax revenue in the community and county schools, and whether wind farms create local industry in the community and result in an influx of new residents to the community, Iowa respondents were consistently 30–35 percentage points lower than the Texas respondents. And while there was strong support for more wind farms, with more than two-thirds in favor of building more wind farms either in their counties or within this U.S. as a whole, as shown in Fig. 3, Iowans were generally less supportive than Texans, by an average of 10–15 percentage points. In addition, only 20% of Iowans felt that the wind farms had increased property values versus 52% of Texas respondents.

So what factors are individuals basing their attitudes on? Krohn and Damborg [41] argue that the positive acceptance of wind power is largely based on public attitudes regarding the benefits of wind *energy*, while the negative opposition of wind power is largely based on public attitudes regarding the negative aspects of wind *turbines*. Our findings appear to be consistent with this view. However, as Swofford and Slattery [9] note, as wind power increases its geographical footprint, multiple factors will inform how people respond to wind farms and that these are often unique to locale. Studies seeking to explain or describe support and opposition regarding wind-power development should focus on the "complex, multidimensional nature of public perceptions of wind farms" [44] rather than simplistic "Not-In-My-Backyard" (NIMBY) or Please-In-My-Backyard (PIMBY) descriptions [18,28,31,53,56]. As Warren and Birnie [27] note, debates regarding wind farms "are complex, multifaceted and passionate, tapping into deeply held beliefs and value systems," while Ellis, Barry, and Robinson [57] argue that "supporters as well as objectors display complex reasons for their respective positions."

We found broad support for wind-power development in west Texas and Iowa largely because of perceived increased employment and economic activity, two important benefits in the eyes of key stakeholders. However, the degree of neutrality on whether tax revenues actually benefit schools and/or the community, and whether wind farm development results in increased property values, indicates concerns regarding two key areas in attracting wind-power development. Ultimately, support for wind power



Fig. 4. View of the Capricorn Ridge wind farm in Coke and Sterling county, Texas.
Source: Michael C. Slattery.

is associated far more with socioeconomic factors than foundational aesthetic or moral values. As van der Horst [16] writes, "residents of stigmatized places are more likely to welcome facilities that are relatively 'green"' while Toke, Breukers, and Wolsink [58] predicted high support in places "perceived as being in economic decline or which are not highly valued as living spaces."

Texas, in particular, appears to be well positioned to see increasing impacts from continued wind development, not only due to greater utilization of instate manufacturing capacity and the development of trained wind industry specific laborers [59], but also because wind developers enjoy such strong local and community support. The irony is that relatively few residents benefit *directly* from the wind farms, because in Texas (and Iowa) all wind farm projects we studied are located on private lands. The "planning" process involves wind developers negotiating contracts with private landowners, which center on royalty payments based on electricity generation, and then leasing the land for wind turbine construction and operation, which the developers themselves own. This obviously provides an added financial incentive for individuals with land suitable for wind turbines. While the broader public is generally excluded from this process, because public meetings generally do not exist or are very poorly attended when they do, there is nevertheless still strong support for the wind farms in these communities, largely because of the perceived local economic impacts but, more importantly, because the wind farms are seen, quite simply, as the vehicle that will reverse economic decline.

5. Conclusions

Using postal and online survey questionnaires in Texas and Iowa, we found a high level of public support for wind energy, with more than two-thirds of respondents being in favor of building more wind farms either in their community or within the U.S. as a whole. Such support for wind farms was independent of age, proximity, or environmental attitude. While general public and political support for wind energy is often high, siting wind farms frequently raises concerns in local communities, and individual projects often fail because of effective public opposition. And while respondents in both states overwhelmingly supported the use of renewable energy in general, and wind energy in particular, to help fulfill U.S. energy demands, they were far more reluctant to support renewables if the source cost more than conventional, fossil-based sources. Our results suggest that arguing for more renewable sources of energy based on reducing our carbon footprint (and, by extension, mitigating against climate change) is less persuasive in these communities than simply approaching it from the perspective of wind being a clean and safe source of energy.

Both in west Texas and Iowa, we found that support for wind power hinged largely on perceived increased employment and economic activity, two important benefits in the eyes of key stakeholders. The majority of respondents to our survey felt wind power development had had an overwhelming positive impact on their economy and community: more than two-thirds indicated that their county had benefited economically from the wind farms and that the wind farms were a source of job creation in the county.

The majority of respondents in both states also felt that wind farms increased tax revenue, which benefitted their community and schools and that wind farms created local industry in the community. And although one-third of respondents indicated that the wind turbines are an unattractive feature of the landscape, an almost equal number felt they were not. Thus, support for wind power in these communities is associated far more with socioeconomic factors than foundational aesthetic or moral values. The irony is that, although relatively few residents benefit *directly* from the wind farms, at least in terms of royalty payments and direct income from the farms themselves, we still found strong support for the wind farms, largely because of the perceived local economic impacts and the fact that wind farms are seen as the vehicle that will reverse economic decline.

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